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GEOLOGICAL SURVEY

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TAKE PRIDE IN AMERICA

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March 11, 1991

Mr. Robert E. Swale, Geological Engineer
U.S. Environmental Protection Agency, Region V
Waste Management Division, Office of Superfund
230 South Dearborn Street
Chicago, IL 60604

Dear Mr. Swale:

This letter is in response to your request for an evaluation of a consultant's analysis of remediation plans at the American Chemical Services NPL site in Griffith, Indiana. You specifically requested our evaluation of the applicability of Modlfow to this analysis and evaluate the consultant's use of Modflow at the Griffith site.

I believe the analysis consists of determining how long and how much pumpage will be required to remove contaminated water from the site under the presence or absence of a slurry wall. Modlfow can be used to provide this information, and specifically, to provide pumpage rates and drawdowns after given periods of times. Modflow can also represent the geologic, hydraulic, and hydrologic conditions at the site. Modpath (a particle-tracking postprocessor for Modflow) could be used with Modflow to show the flow paths induced by pumpage. Modpath can illustrate how the contaminant plume is removed over time. I will further discuss the importance of using this technique in a subsequent paragraph. The rest of our comments pertain to the consultant's use of Modflow.

After reviewing geologic information for the site, the modeler is probably correct to use a single water-table layer with an aquifer bottom at 620 feet for flow analysis. The second, deeper aquifer is separated from the upper aquifer by about 10 feet of clay which limits interaction between the two aquifers. On the basis of rough calculations, the proposed remedial pumpage would prevent less than 5 gallons per minute from leaking, therefore, estimated drawdowns would not be greatly affected. However, the consultant's geologic description mentions that fractures in the clay are present and the clay has been measured as thin as 2.5 feet. The lower aquifer could have been contaminated by downward leakage in the more conductive areas of the clay layer. Water-quality analyses from the lower aquifer could indicate whether contamination has occurred, but we could not find water-quality analyses in the report.

The remainder of the comments describe our concerns with the model design and our suggestions for model improvement.

1. The upper aquifer is described as sand, and the specific yield chosen would normally be associated with a clean, coarse sand. However, the hydraulic conductivity chosen (2.5 ft/d) suggests a silty sand. The consultant's grain-size analysis data indicates that 80 percent of the aquifer material is sand size and that 90 percent is greater in diameter than a fine sand. Apparently, the consultant has aquifer-test data that indicates hydraulic conductivity is 2.5 ft/d. Possibly, the consultant's data analysis could be checked, or an actual aquifer test with pumping and observations wells could be done, as suggested in the report to obtain a more accurate conductivity and specific yield. From what I know of the area, conductivity would more likely be from 50 - 150 ft/d, and specific yield would be from 0.1 to 0.30. If conductivity is greater than 2.5 ft/d, then time required to evacuate the contaminant may be less.

2. In a small area model such as this, it is important to include in a sensitivity analysis the sensitivity of heads, pumpage rates, and boundary flux to boundary conditions. The pumpage is close to the boundaries, and drawdowns may develop differently for different boundary conditions. The modeler should be able to justify their choice of boundary conditions, particularly a constant-head boundary, but this was not done. Perhaps another pumping plan could be done without a constant-head boundary. My feeling is that the best solution to boundary conditions in this case may be to extend the model boundaries to natural hydrologic boundaries or use the "General Head Boundary" option to Modflow for more of the boundaries, unless something else could be justified.

3. One point that I was confused about was that all the REM's (remedial pumping plans) assumed a recharge rate of 12 inches per year, but on page 5 of the modeling section, it is stated that 4 inches was used. Why was calibration done at 4 inches and all the REM's at 12 inches?

4. I noticed that the fire pond, which receives surface runoff, does not influence any of the drawdown contours shown for the REM's. I would have expected the pond to leak into the aquifer and develop a ground-water mound around the pond. Is it assumed that the pond is removed in the pumping plans?

5. The modeler states on page 3 that for REM4 (no slurry wall), dewatering was less effective. In other words, because drawdowns are not as great, not as much contaminate is removed without the slurry wall. However, the contaminant may still be flushed away by outside water induced into the contaminated area by the pumping. Previously, I mentioned that Modpath could be used with Modflow results. Modpath would show the flow lines going into the pumping wells and would show the amount of movement and removal of water in contaminated areas. The results of REM4 may be better than originally thought. Modpath could also be used in the steady-state analysis as a more accurate and informative substitute for the five hand-calculated flow lines.

6. The modeler states that using "drains" rather than actual pumpage nodes to simulate water removal results in developing optimal pumpage rates, and that is correct. But I would suspect that, in practice, optimal pumpage rates would be difficult to maintain. It would mean constant adjusting of pumpage rates, and I would not expect an individual would be available to do that. If optimal rates are not maintained, then more time would be required to evacuate the water than the time reported.

7. Only one pumping-well arrangement was tested, but it would seem informative to experiment with the placement and number of pumping wells to achieve a minimum pumping time or minimum pumping cost to remove the contamination.

8. I am not sure how much diffusion and dispersion of the contaminant has occurred. Perhaps the modeler could show a map of the contamination plume so that the reader can see that the given pumping-well placement has a chance of removing all the contaminant.

If my suggestions were done, the modeling results may not be greatly different from those described in the report. However, if the additional checks, simulations, and explanations were done, then a greater degree of confidence in the results would be developed.

For the District Chief.

Les Arihood

Leslie Arihood
Hydrologist

Enclosure